

Disease eradication as a public health strategy: a case study of poliomyelitis eradication

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Disease eradication as a public health strategy was discussed at international meetings in 1997 and 1998. In this article, the ongoing poliomyelitis eradication initiative is examined using the criteria for evaluating candidate diseases for eradication proposed at these meetings, which covered costs and benefits, biological determinants of eradicability (technical feasibility) and societal and political considerations (operational feasibility). The benefits of poliomyelitis eradication are shown to include a substantial investment in health services delivery, the elimination of a major cause of disability, and far-reaching intangible effects, such as establishment of a "culture of prevention". The costs are found to be financial and finite, despite some disturbances to the delivery of other health services. The "technical" feasibility of poliomyelitis eradication is seen in the absence of a non-human reservoir and the presence of both an effective intervention and delivery strategy (oral poliovirus vaccine and national immunization days) and a sensitive and specific diagnostic tool (viral culture of specimens from acute flaccid paralysis cases). The certification of poliomyelitis eradication in the Americas in 1994 and interruption of endemic transmission in the Western Pacific since March 1997 confirm the operational feasibility of this goal. When the humanitarian, economic and consequent benefits of this initiative are measured against the costs, a strong argument is made for eradication as a valuable disease control strategy.

Keywords: cost-benefit analysis; immunization programmes, case studies, and organization and administration; poliomyelitis, prevention and control; programme evaluation.

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Introduction

"Elimination and eradication are the ultimate goals of public health, evolving naturally from disease control" (1). Despite the humanitarian and economic rationale behind this statement, a number of commentators continue to question whether the benefits of such initiatives warrant the human and financial costs and the tremendous focused effort required to eradicate a disease. As a result, two major international meetings were convened recently to examine the concept of disease eradication as a public

health strategy: a workshop on the eradication of infectious diseases held in Dahlem, Germany, from 16 to 22 March 1997 (2); and a conference on global disease elimination and eradication as public health strategies, held in Atlanta, GA, USA from 23 to 25 February 1998 (3). As a starting point, these meetings sought to define the criteria for targeting a disease for eradication, not only in terms of the biological determinants of eradicability, but also in terms of the costs and benefits, and societal and political considerations (1).

Ten years into the largest disease eradication initiative ever launched, it is both timely and instructive to re-examine the goal of poliomyelitis eradication by the end of the year 2000 in light of the criteria put forward at the Dahlem and Atlanta meetings. Three questions are considered.

- Why eradicate poliomyelitis? (costs and benefits).
- Why is poliomyelitis eradication technically feasible? (biological determinants of eradicability).
- Why is poliomyelitis eradication operationally feasible? (societal and political considerations).

This article begins by outlining the current status of the eradication initiative and closes with a summary of the major challenges now and in the post-poliomyelitis eradication era.

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Current status of the poliomyelitis eradication initiative

The goal of eradicating poliomyelitis by the end of the year 2000 was adopted by the World Health Assembly in 1988 (4). Since then, poliovirus has disappeared rapidly from large areas of the world. At the same time, the capacity to control other important diseases has improved worldwide. The number of poliomyelitis cases has fallen by over 95% around the world, from an estimated 350 000 in 1988 to an estimated maximum of 20 000 in 1999, with the elimination of wild poliovirus from three of the five continents where it was endemic at the outset of the initiative (5).

The western hemisphere was certified as poliomyelitis-free in 1994 (6), and the last case of paralysis due to endemic wild poliovirus in the WHO Western Pacific Region was identified in March 1997. In the WHO European Region, wild poliovirus was last identified in November 1998 in south-east Turkey. By the end of 1999, poliomyelitis had disappeared from much of the eastern Mediterranean area and no virologically confirmed cases had been reported from south and north Africa for more than two years, with the exception of Egypt (5). The geographical extent of the remaining poliovirus circulation continues to shrink. At the end of 1999, wild polioviruses were circulating in a maximum of 30 countries, primarily in sub-Saharan Africa and South Asia (Fig. 1).

Details of the four principal strategies that have been central to the success of the poliomyelitis eradication initiative — strong routine immunization programmes, national immunization days (NIDs), surveillance for acute flaccid paralysis (AFP) and house-to-house “mop-up” operations — have been described elsewhere (7, 8). The present article focuses on the eradication initiative in the context of the major criteria for such initiatives that were outlined at the Dahlem and Atlanta meetings.

Why eradicate poliomyelitis?

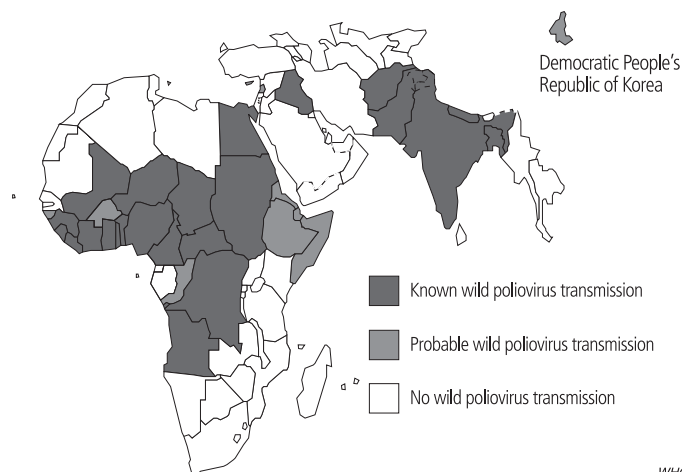
The attractions of disease eradication as a public health strategy are manifold. From a humanitarian perspective, eradication provides the ultimate in health equity and social justice, bringing identical and universal benefits to every person globally (9). From an economic perspective, a successful eradication initiative ultimately results in the cessation of all control measures, thereby freeing already scarce health resources for other purposes. Because an eradication initiative does not exist in a vacuum, the consequent effects on the larger health system in which it operates are as important as the direct benefits (1). Thus, the decision to launch an eradication initiative cannot simply follow the argument “because it is possible”, but rather can only be taken after demonstrating that both the direct and consequent effects are positive.

The magnitude of the direct humanitarian benefits of ensuring that the crippling effects of poliomyelitis will never again be experienced by any person seem to be under-appreciated. In the absence of vaccination, 0.5% of children (i.e. 650 000) in every annual birth cohort of about 130 million infants would become paralysed as a result of poliovirus infection (10). As recently as 1988, the year the eradication goal was adopted, an estimated 350 000 cases of paralytic poliomyelitis were still occurring (7). Because the majority of victims survive the acute illness, the prevalence of chronic polio paralysis may be as high as 20 million cases. Lameness surveys in the 1970s revealed poliomyelitis to be a leading cause of permanent disability in developing countries with low immunization coverage (11, 12). Surveys in Afghanistan and Cambodia in the 1990s demonstrated that poliomyelitis continues to be a leading cause of permanent disability among children in war-torn countries (13).

Economic analyses of disease eradication remain problematic and somewhat controversial, primarily because of the lack of consensus on how to value benefits that accrue in perpetuity, particularly when the majority of disease occurs in developing countries (14). For example, the value of the suffering and human life lost associated with permanent disability due to poliomyelitis is difficult to quantify. Despite these limitations, several attempts have been made to estimate the economic costs and benefits of poliomyelitis eradication (15, 16). The most comprehensive analysis, even though focused primarily on the costs and benefits in industrialized countries, estimated annual global savings of US\$ 1.5 billion per year once poliomyelitis has been eradicated and all control measures stopped (15).

The consequent benefits of poliomyelitis eradication are as substantial as the direct benefits. Consequent benefits formed the basis for launching the initiative in the Americas (17) and were subsequently embraced in the World Health Assembly resolution establishing the global target (4). As important as the eradication of the disease itself was

Fig. 1. Status of wild poliovirus transmission in 1999, based on data reported to WHO up to February 2000. Wild poliovirus importations were also detected in China, the Islamic Republic of Iran and Myanmar in 1999



the boosting of struggling immunization programmes and, especially, establishment of sensitive surveillance systems (18). With the maturing of the poliomyelitis eradication initiative, several careful studies have evaluated the consequent effects in the Americas (19), the Western Pacific (20), Lao People's Democratic Republic, Nepal and United Republic of Tanzania (21), and India (22). In general, these studies found that the poliomyelitis initiative had more positive than negative effects on health systems and other health services.

The major opportunities for consequent benefits involve improvements in health services delivery, particularly in the control of vaccine-preventable diseases. The studies noted increased national financing of immunization systems and vaccine purchases (19, 23), increased routine coverage in many countries (20), and improved community participation and ownership (19, 21, 22). Poliomyelitis eradication resources have supported a tremendous increase during 1988–99 in the numbers of WHO staff working on immunization at the global, regional and country levels (Fig. 2). Table 1 outlines how routine immunization and surveillance infrastructures were strengthened in most of the poliomyelitis-endemic countries of the Western Pacific Region, despite the demands imposed by ongoing eradication activities. The impact of improvements in the delivery of other health services was found to depend on the particular country. In countries with vitamin A deficiency, for example, the delivery of vitamin A during poliomyelitis NIDs was especially important given that supplementation can reduce all-cause mortality in young children by an average of 23% in such countries (24–27). As significant as the improvements in service delivery was the enhanced capacity to evaluate their impact. Global surveillance capacity has been strengthened thanks to tens of thousands of health workers having been trained, the provision of equipment and transport to resolve logistic impediments, the development of a functioning communications network for the electronic submission and feedback of surveillance results, and the establishment of a global laboratory network (23, 28–30). The sustainability of these gains will depend on continued financing for and political interest in preventive health services.

Because human and financial health resources are limited, eradication programmes must be sensitive to the risk of diverting resources from other priority health needs, particularly in countries where strong health systems are not in place (9, 31, 32). The demand that poliomyelitis NIDs place on a country's human resources has been an ongoing concern. However, the diversion is of short duration for most NID workers and is often accommodated by existing inefficiencies within the health system, particularly at the peripheral level (21). While the diversion of financial resources to poliomyelitis eradication has occurred in some areas, the poliomyelitis initiative has also attracted partners that do not ordinarily contribute funds to international health programmes

Fig. 2. Number of WHO staff working on immunization at the country, regional and global levels in 1988, 1995 and 1999

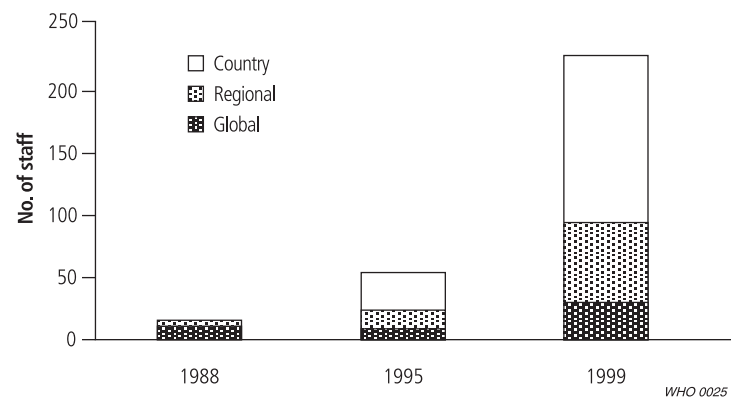


Table 1. Selected indicators of the evolution of the Expanded Programme on Immunization (EPI) in countries of the WHO Western Pacific Region that were poliomyelitis-endemic in 1994^a and conducted poliomyelitis eradication activities during 1994–97

Indicator	No. of countries (n = 7)
Expansion of AFP surveillance system to other EPI diseases^b	
Any disease	6
Measles	6
Neonatal tetanus	5
Diphtheria	2
Meningitis	1
Inclusion of vitamin A in national immunization days	4
Injection safety plan of action	
Implemented	3
Drafted	3
Cold chain refurbishment	
Any refurbishment	6
Major refurbishment	4
Partial refurbishment	2
Other supplementary disease control activities	
Any other supplemental immunization activity	7
Measles vaccine campaigns	4
Tetanus toxoid campaigns	4
Diphtheria toxoid campaigns	2
Meningitis vaccine campaign	1
Self-sufficiency: level of government funding for EPI activities	
High level of support maintained	1
Major increase in support	2
Minor increase in support	2

^a Cambodia, China, Lao People's Democratic Republic, Mongolia, Papua New Guinea, Philippines, and Viet Nam.

^b AFP, acute flaccid paralysis. Currently implemented in four of the six countries.

(30, 33); by the end of 1999, approximately 50% of the external needs of poliomyelitis eradication had

been met by two such organizations. Rotary International has already contributed approximately US\$ 400 million and will add another US\$ 100 million over the expected lifetime of the programme (30). The Centers for Disease Control and Prevention (CDC) has assumed a donor role for the first time specifically for this initiative. CDC technical support is also being provided, following on the tradition established during the smallpox eradication initiative.

While the direct effects of poliomyelitis eradication appear self-evident to many, the reality is that eradication initiatives result in both opportunities and threats to health systems development, and appropriate planning is essential to maximize the positive effects (34). Today, at the dawn of the twenty-first century, poliomyelitis eradication may provide one of the best models for reaching underserved populations and fostering global equity in health.

Why is poliomyelitis eradication technically feasible?

The eradicability of a disease is a function of the biology of the causative organism and the tools available to combat it. The Dahlem workshop identified three indicators that were of primary importance in determining the technical feasibility of eradicating a particular organism (35).

- Availability of an effective intervention and delivery strategy that can interrupt transmission of the organism.
- Practical diagnostic tools with sufficient sensitivity and specificity to detect levels of infection that can lead to transmission.
- Absence of a non-human reservoir — humans are essential for the life cycle of the organism, which has no other vertebrate reservoir and does not amplify in the environment.

We begin with the last of these because, regardless of the effectiveness of an intervention, the eradication of an organism, as defined in part by the capacity to stop all control measures, is not feasible unless, first of all, this criterion is met.

Absence of a non-human reservoir

Observations have consistently indicated that poliovirus cannot amplify in the environment or in non-primate animal species; humans are essential to the life cycle of this virus. Poliovirus-neutralizing sera have been found in other vertebrates such as cows, horses, chickens, dogs, goats and sheep, but without evidence of infection (36). Paralytic poliomyelitis has been described among chimpanzees, orang-utans and gorillas in captivity and chimpanzees in nature (37, 38). These species are likely incidental hosts, however, and surviving populations in the wild are too small and geographically scattered to sustain

poliovirus transmission or pose a threat for re-seeding human populations once eradication has been achieved (39). Similarly, viable virus cannot be found in sewage or surface water for more than several weeks after circulation ceases among humans (39). The question of persistence in permafrost or the polar ice caps has not been definitively answered, but the means by which such preserved polioviruses could infect a human population are unclear or involve extreme assumptions (39).

The absence of a long-term carrier state is critical to the cessation of control measures and to reap the financial benefits that are implicit in the definition of eradication. Although chronic infection with wild-type poliovirus has never been described (40), vaccine-derived polioviruses have the potential to establish prolonged replication and excretion in persons with certain immune deficiency disorders, particularly B-cell defects (41–43). While prolonged infection with vaccine-derived polioviruses was recognized at the outset of the eradication initiative, the duration and hence implications of such chronic infections may have been underestimated.

Resolution of these issues is vital for the ultimate success of the poliomyelitis eradication initiative, as the direct economic benefits are highly influenced by when cessation of immunization occurs. In March 1998, a specially convened WHO working group, basing its conclusions on the best available scientific evidence, stated that vaccination with oral poliovirus vaccine (OPV) can stop and that with inactivated poliovirus vaccine (IPV) should stop when eradication is certified, laboratory stocks of poliovirus are contained, and there is no evidence of persistent vaccine-derived poliovirus circulation (44). A 13-member independent global certification commission has established a certification process based on the absence of poliovirus for at least a 3-year period in the presence of excellent surveillance (45). Laboratory containment guidelines have been established following a period of public comment (46), and an ambitious research agenda is currently being implemented to determine with more precision the risk of chronic infection with vaccine-derived poliovirus according to the type of immunodeficiency disorder (40, 47). Early findings suggest that prolonged virus excretion is very rare, even in immunodeficient persons. Moreover, even if such persons are able to transmit virus, it may be possible to clear infection with new antiviral drugs (48, 49).

Effective intervention and delivery strategy

When the global target to eradicate poliomyelitis was set in 1988, there was some controversy as to how eradication would be achieved, both in terms of the vaccine to be used and the strategy by which it would be delivered (50). Theoretically, the eradication initiative could rely on two excellent vaccines to interrupt transmission: IPV and OPV. However, IPV appears to have interrupted poliovirus trans-

mission only in three industrialized countries in northern Europe (Finland, the Netherlands, and Sweden). In practice, only OPV has been found to be capable of stopping transmission in current or recently endemic countries, particularly those with tropical climates. On a biological or technical basis, OPV was selected as the vaccine of choice for the eradication initiative because it induces secretory intestinal immunity superior to that induced by IPV and spreads from vaccinees to their close contacts, thereby protecting some unimmunized children (51–53). Ultimately, the low cost and oral administration route of OPV proved to be additional characteristics that made this vaccine much more suited to the mass delivery strategy required.

To stop poliovirus transmission in highly endemic, tropical developing countries the choice of vaccine had to be matched by an appropriate delivery strategy. As early as the 1950s, mass OPV vaccination was advocated by Sabin and was tested on a large scale during field trials in the former Soviet Union in 1959–60 (54, 55). Application of this strategy led to interruption of poliomyelitis transmission in Cuba in 1962 (56). Experience from Brazil, which demonstrated an immediate and sustained decrease in poliomyelitis cases when it started to add mass campaigns to routine immunization services in 1980, encouraged the public health community to hope that poliomyelitis eradication might be feasible (57).

Despite the success of this campaign strategy, which later evolved into NIDs, debate on the choice of vaccine delivery strategy for global poliomyelitis eradication continued. The discussions were in part fuelled by the evolving international consensus, enunciated at the 1978 International Conference on Primary Health Care held in Alma-Ata, on the need to strengthen primary health care systems and minimize the use of mass campaigns (58). Although routine immunization increased steadily after the establishment of the Expanded Programme on Immunization (EPI) in 1977, reaching about 80% of the world's infants by 1990 (59), routine coverage alone was not sufficient to stop wild poliovirus transmission in most developing countries (60).

The reasons for persistent poliovirus transmission despite high routine OPV coverage were first described in India in 1975, where it was shown that three doses of OPV in the first year of life produced only 75–85% seroconversion against type 1 poliovirus and even less against type 3 (61). Neither additional doses of OPV nor a mixed OPV–IPV schedule proved operationally successful in resolving this issue. In addition, routine immunization coverage stagnated in the early 1990s at 80% globally and below 50% in Africa (59). In the early 1980s, the Pan American Health Organization (PAHO) introduced the systematic use of NIDs, during which two doses of OPV per year were administered over as short a time period as possible to all children aged less than 5 years, regardless of prior immunization status. Subsequently, the rapid interruption of poliomyelitis

transmission in the Americas by 1991, and significant progress using mass campaigns in the Western Pacific Region, brought an end to the debate. Routine immunization was recognized to be the base upon which eradication would be achieved, while the addition of NIDs was confirmed as essential to the interruption of poliomyelitis transmission in many countries (Fig. 3).

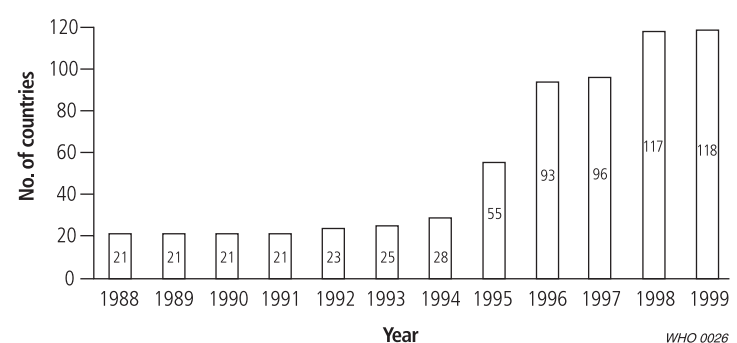
Sensitive and specific diagnostic tools

Although tools for the laboratory diagnosis of poliomyelitis infection were available at the outset of the poliomyelitis eradication initiative, the strategy for employing those tools had to be adapted to the needs and operational realities of the programme. Unlike the characteristic rash and consequent scarring caused by smallpox, the great majority of poliovirus infections are subclinical (62). Even for the 0.5% of infections that result in paralysis, the diagnosis of wild poliovirus infection cannot be made on clinical grounds alone. The occurrence of vaccine-associated paralytic poliomyelitis, and paralytic syndromes similar to poliomyelitis but caused by other enteroviruses, emphasizes the need for highly reliable laboratory diagnosis (63).

The simplest and most practical tool for diagnosis of virus infection is serological testing, which requires blood samples. Although such testing is a familiar and reliable tool in many laboratories, in practice it is inadequate for the diagnosis of poliomyelitis. Paired specimens are needed and, despite repeated attempts, no serological test has been devised that can distinguish antibodies produced by wild polioviruses from those produced by the vaccine. Viral culture from stool specimens therefore became the method for diagnosing poliomyelitis (64). Virus isolation is virtually 100% specific, particularly with the introduction of new molecular methods that reliably distinguish vaccine-derived from wild-type virus (65). However, viral culture demands a more complicated operational strategy.

First, a method of surveillance that detected all possible poliomyelitis cases was required. In the Region of the Americas, a strategy of acute flaccid

Fig. 3. Cumulative number of countries having conducted national immunization days (NIDs) with oral poliovirus vaccine in 1988–99, based on data reported to WHO as of 1 March 2000



paralysis (AFP) surveillance evolved, whereby all cases of AFP in persons aged less than 15 years were to be reported and investigated, with collection of two stool specimens (66). Rapid reporting was necessary to ensure that specimens were obtained while virus was still being excreted at a high titre (within 2 weeks of onset) and massive logistics were required for a reverse cold chain to keep specimens cool during transport from the field to the laboratory.

Second, the surveillance strategy had to be sufficiently robust to permit international monitoring and comparison of performance indicators (67) (Fig. 4). Because AFP cases occur even in the absence of poliomyelitis, a standard of ≥ 1 case of non-poliomyelitis AFP per 100 000 population aged less than 15 years was empirically defined in the Americas as the principal indicator of surveillance sensitivity for poliomyelitis eradication. The appropriateness of this standard was later validated through studies of Guillain-Barré syndrome in the USA and Canada and the practical application of the AFP strategy worldwide (68–70). Although many countries initially claimed that their AFP rate was lower than this standard, surveillance reviews invariably identified many previously unreported cases (28). In the years following eradication, the standard will allow countries to demonstrate that surveillance has been of sufficient quality to permit certification (45).

Third, a more sophisticated infrastructure, consisting of a three-tiered global network of enterovirus laboratories, had to be developed to ensure reliable isolation, identification and genomic characterization of poliovirus from the stool specimens of AFP cases (28, 71) (Fig. 5). Time-lines and cost restrictions dictated that only existing facilities were used; 148 laboratories are now involved. National and subnational laboratories are responsible for primary processing of specimens and identifying any viruses grown. Regional reference laboratories distinguish wild virus from vaccine strains, while specialized reference laboratories, and some regional reference laboratories, undertake genomic sequencing to help determine transmission pathways, virus importations, and remaining reservoirs of poliovirus (72, 73).

Finally, a laboratory accreditation system was established, with additional training, reagents and equipment provided as necessary (71). Because false-positive or false-negative specimens can have disastrous consequences, results are only accepted from accredited laboratories.

Why is poliomyelitis eradication operationally feasible?

Even though the tools to interrupt transmission and diagnose infection of an organism may be available, the operational realities of their effective application, especially under difficult circumstances, will determine the overall feasibility of its eradication. Central to the operational feasibility of an eradication initiative is the level of societal and political commitment (74). For an infectious disease such as poliomyelitis, which has a global distribution and can readily become re-established in areas where it is not currently endemic, it is necessary to persuade all countries to implement the established strategies and maintain them until global eradication is achieved (5). Because the poliovirus does not respect national borders in its ability to circulate, the success of any country in the eradication effort is contingent on the success of every country.

Understanding the process of developing and maintaining political and societal consensus is essential to the success of an eradication programme. The Dahlem workshop discussed a framework of social and political criteria that must be applied and satisfied in order to move from a disease control programme to a disease eradication effort (74). Those aspects of the framework that have not been previously discussed in this paper are described below.

The eradication strategy for a particular disease must not only be technically feasible, but have been field-tested in a large geographical area and demonstrated to be both effective and operationally feasible. In 1985, the WHO Region of the Americas adopted a resolution calling for the eradication of poliomyelitis by the year 1990 (75). This initiative provided the first demonstration that poliomyelitis eradication in a large geographical area (the western hemisphere) was operationally feasible, as well as providing a field laboratory for implementing and fine-tuning eradication strategies before launching the global effort. Progress was rapid, so that by 1988, when the World Health Assembly declared the global eradication goal, poliomyelitis had been eliminated from 25 of the 34 countries of the Americas (66). When the initiative was formally launched in Africa, the last of the six WHO Regions to do so, the Americas had already been certified as having eradicated poliomyelitis and a second WHO Region, the Western Pacific, was almost poliomyelitis-free (6, 76).

Consensus review by technical experts must justify the priority for eradication of a disease before a global initiative is launched. In the case of poliomyelitis eradication, such consensus was gradually

Fig. 4. Annual rates of non-poliomyelitis acute flaccid paralysis (AFP) per 100 000 children under 15 years of age, by WHO region, 1996–99, based on data reported to WHO up to February 2000

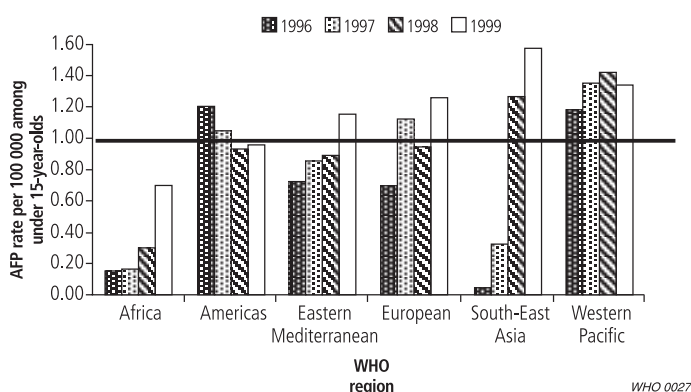
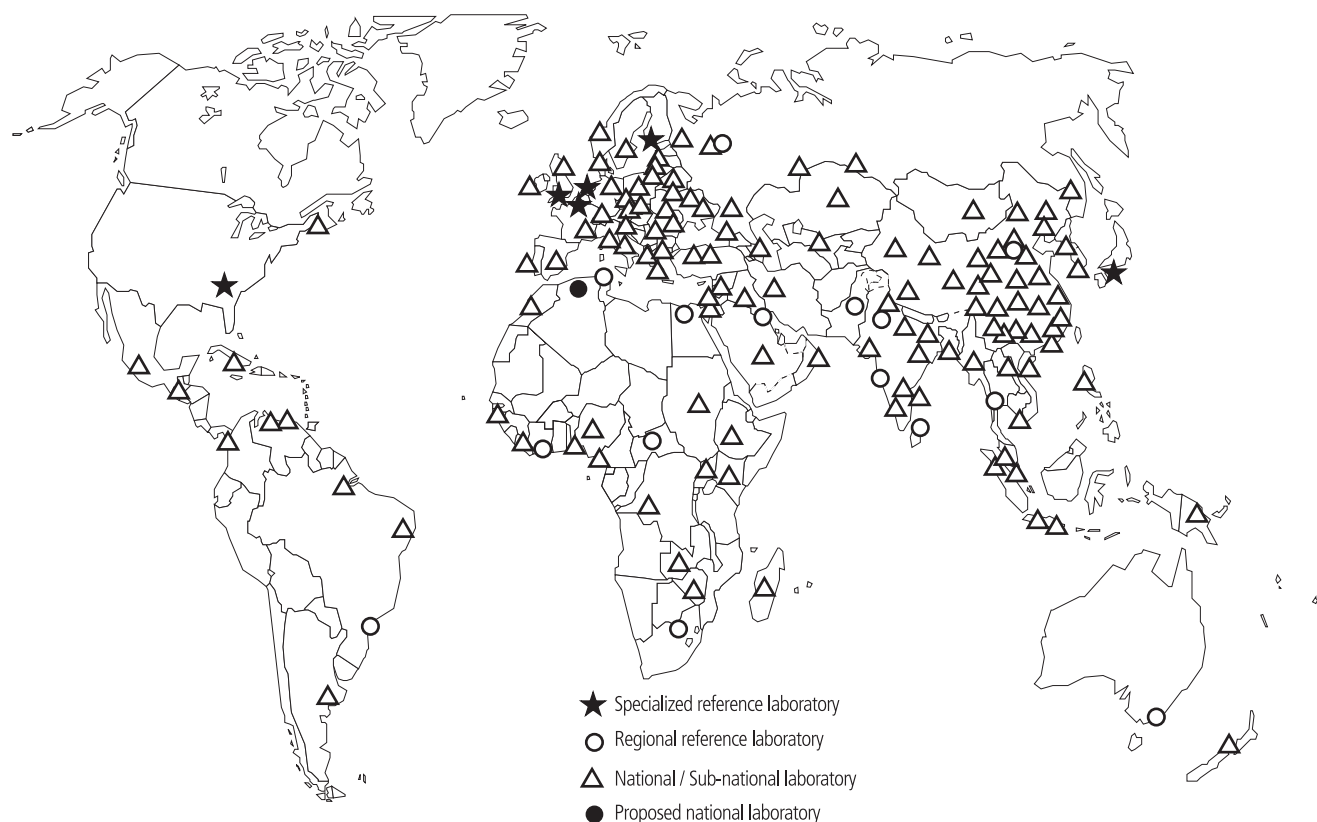


Fig. 5. Global laboratory network for poliomyelitis eradication up to 1 March 2000



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developed during the 1980s, and was hastened by the rapid progress observed in the Americas and the Western Pacific. Despite consensus on the technical and operational feasibility of poliomyelitis eradication, a lack of consensus on the priority it should be afforded and the particularly vocal opprobrium of some critics have continued to threaten the initiative. Political commitment and leadership from the highest levels have been essential to overcoming such concerns, particularly with the accelerated disappearance of the disease and the subsequent increase in the marginal costs per case averted.

Political commitment to the global eradication of poliomyelitis was initially achieved in 1988 when the World Health Assembly unanimously adopted resolution WHA41.28 (4). One of the main factors contributing to the progress achieved since then has been the repeated involvement in the initiative by the heads of state of key poliomyelitis-endemic countries. For example, President Jiang Zemin of China administered the first OPV dose in the very first NID in China in 1993 during a nationally televised ceremony. The Prime Minister of India has played a similar role each year since 1995. In 1996, the WHO Regional Director for Africa established the Committee for a Poliomyelitis-free Africa, consisting of prominent figures from throughout the continent and with South African President, Nelson Mandela, as its Chairman (77). The African heads of state attending the summit of the Organization of African Unity in Yaoundé, Cameroon, from 8 to 10 July 1996 approved

a declaration in support of poliomyelitis eradication (78). These and many other examples have clearly indicated that high-level political commitment is critical if the human and financial resources necessary to implement the poliomyelitis eradication strategies in every country are to be obtained.

An eradication programme requires a comprehensive plan for advocacy which must be continuously updated in accordance with changing circumstances and needs. Recruitment of partners and coordination of resources at the national, regional and global levels are essential. At the global level, support for poliomyelitis eradication has been maintained through efforts such as the adoption by the World Health Assembly in May 1999 of a resolution reaffirming WHO's commitment to the global eradication of poliomyelitis by the end of 2000 and urging poliomyelitis-endemic Member States to accelerate eradication activities (79). The poliomyelitis initiative has been particularly fortunate in having had from the outset a global private sector partner, Rotary International, whose role has gone far beyond the provision of funding to include a substantial advocacy and public information component (30). At the regional and country levels, poliomyelitis eradication has become an unprecedented model for collaboration and coordination in the health sphere through the Interagency Coordination Committee (ICC) mechanism. Social mobilization campaigns have been essential advocacy tools among the general population at the country level.

Most notable of these has been the “Kick Polio Out of Africa” campaign, which has used football events to promote NIDs and other eradication activities.

It is possible to build on the political and societal momentum of a successful eradication initiative to provide the impetus for launching a new eradication effort; this can also prove beneficial to the original initiative. For example, even before poliomyelitis eradication had been achieved throughout the Americas, the political authorities of countries in the region that had attained the goal were urging a move into measles elimination to capitalize on the gains made by the poliomyelitis initiative. This not only made it possible to secure continuing political commitment and financing for immunization programmes, but also facilitated the sustaining of the disease surveillance system long after regional certification of poliomyelitis eradication (80).

Major challenges to the ultimate success of the poliomyelitis eradication initiative

The technical feasibility of poliomyelitis eradication is well established and the operational feasibility of achieving it has been demonstrated under every circumstance imaginable. The essential poliomyelitis eradication strategies have been introduced into every country of the world, regardless of geography, climate, culture, civil strife or outright war. The ultimate success of the initiative now hinges on three factors.

First, the gains made to date must be rapidly consolidated through an acceleration of the programme, particularly in the ten global priority countries (5) (Fig. 6). The capacity to implement

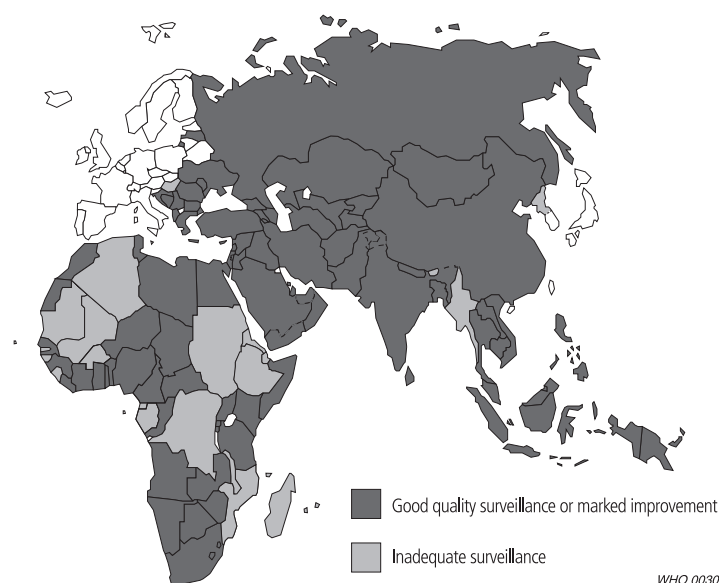
eradication strategies fully and consistently must be sustained in conflict-affected areas, in particular, Afghanistan, Angola, the Democratic Republic of the Congo and parts of Somalia and Sudan. In the five densely populated countries that are considered to be global reservoirs for poliomyelitis and account for more than 70% of the world's cases (Bangladesh, Ethiopia, India, Nigeria and Pakistan), it will be necessary to almost double the current level of supplementary immunization activities during the period 2000–01. The scale of these accelerated activities is such that India alone will have delivered nearly 1 billion doses of OPV during six rounds of supplementary immunization between October 1999 and March 2000.

Second, additional financial resources will be essential for implementing the acceleration called for by the World Health Assembly in May 1999 (79) and described above. An estimated US\$ 300 million will be required between 2000 and 2005, the target date for global certification, to implement fully the ambitious programme of extra NIDs rounds, rapid improvements in AFP surveillance and early and aggressive use of house-to-house mop-up campaigns. Such figures are challenging; however, substantial amounts have already been pledged or contributed (Fig. 7). Grants totalling US\$ 78 million from the United Nations Foundation and the Bill and Melinda Gates Foundation have helped to launch the acceleration agenda. New private sector partnerships are being forged, such as the recently announced contribution of the DeBeers Corporation to the eradication initiative in Angola. An in-kind donation from OPV manufacturer Pasteur-Mérieux-Connaught will help cover vaccine needs in the conflict-affected countries of Africa. Also, the World Bank has announced that it will join with the Government of India to facilitate the massive acceleration planned in that country.

Finally, it will be essential to maintain and indeed enhance commitment from the highest possible level among United Nations agencies, poliomyelitis-endemic countries, donor nations and partner organizations. Maintaining supplementary immunization and surveillance activities through the poliomyelitis-free, pre-certification period through 2005 will be a particular challenge. It will require an ongoing and consistent high level of advocacy, linked to a well-communicated public relations campaign that addresses a much larger constituency. Complacency or cynicism in the face of disappearing disease is one of the greatest threats to realizing the ultimate success of this global public health initiative.

The post-eradication era will present new challenges, including a massive effort to ensure the safe containment of laboratory stocks of wild polioviruses, a final surveillance push prior to global certification and, perhaps most difficult of all, implementation of a globally coordinated strategy to stop OPV immunization once and for all. Given the rare but real risk of vaccine-associated paralytic poliomyelitis, the use of current OPV strains may

Fig. 6. Quality of acute flaccid paralysis (AFP) surveillance in countries of the WHO African, Eastern Mediterranean, European, South-East Asian, and Western Pacific Regions, based on data reported up to 1 March 2000



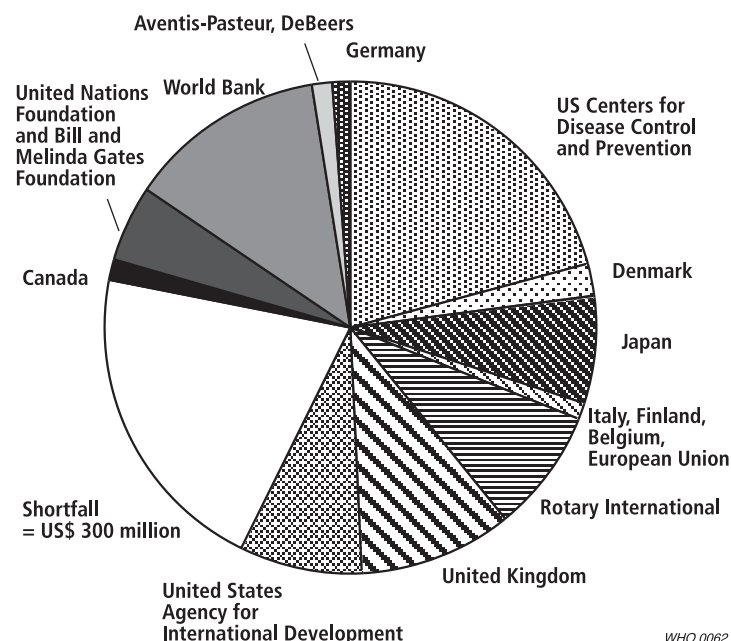
need to stop soon after certification of eradication. Ongoing research will determine which, if any, vaccines may be needed in the post-eradication era.

Conclusion

The initiative to rid the world forever of poliomyelitis is providing important lessons about the value of eradication as a public health strategy. The benefits are impressive — the elimination forever of a leading cause of permanent disability, a substantial investment in health services delivery and, perhaps most importantly, far-reaching intangible effects such as the establishment of the “culture of prevention” described in the Americas (19). The costs, meanwhile, are financial and finite. Undoubtedly there has been some disturbance to the daily delivery of other health services, which may continue for another few years. In contrast to the promise of a poliomyelitis-free world, however, there is nothing to suggest that these distractions will be anything but transient.

In his closing remarks to the 1998 Atlanta conference on disease eradication as a public health strategy, Dr W.H. Foege commented “... the bottom line is that eradication attacks inequities and provides the ultimate in social justice” (87). When such principles are coupled with the humanitarian, economic and consequent benefits of an initiative such as that ongoing against poliomyelitis, the argument for eradication as a valuable disease control strategy is strong. ■

Fig. 7. Status of confirmed and projected contributions (financial and in kind) to the global poliomyelitis eradication initiative for 1999–2005, based on data reported to the WHO Department of Vaccines and Biologicals as of 1 March 2000 (total estimated external resource required = US\$ 1.25 billion)



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Résumé

L'éradication des maladies en tant que stratégie de santé publique : l'exemple de l'éradication de la poliomyélite

Malgré les raisons humanitaires et économiques qui sous-tendent les initiatives d'éradication des maladies, certains commentateurs se demandent si le coût humain et financier de telles initiatives justifient les efforts nécessaires pour parvenir à l'éradication d'une maladie. Deux réunions internationales ont été récemment organisées à ce sujet pour examiner le concept d'éradication en tant que stratégie de santé publique, la première à Dahlem (Allemagne) en 1997 et la deuxième à Atlanta (Etats-Unis d'Amérique) en 1998. Dix ans après le lancement de la plus vaste campagne d'éradication jamais tentée, il est utile de réexaminer l'objectif de l'éradication de la poliomyélite à la lumière des critères proposés lors de ces réunions, en se posant les trois questions suivantes : « Pourquoi éradiquer la poliomyélite ? » (coûts et avantages), « Pourquoi l'éradication de la poliomyélite est-elle techniquement réalisable ? » (déterminants biologiques de l'éradicabilité), et « Pourquoi l'éradication de la poliomyélite est-elle opérationnellement réalisable ? » (considérations sociétales et politiques).

Une initiative d'éradication ne peut être lancée que lorsqu'il a été démontré que ses effets directs et à plus long terme seront positifs. Parmi les avantages de

l'éradication de la poliomyélite figurent l'investissement important dans la prestation des services de santé, l'élimination d'une cause majeure d'incapacité, et des effets intangibles mais d'une grande portée comme la création d'une « culture de la prévention » comme cela a été le cas dans les Amériques. Bien que le coût financier de l'initiative soit important, l'économie annuelle qui sera réalisée à l'échelle mondiale lorsque toutes les mesures de lutte contre la poliomyélite pourront être arrêtées sera de l'ordre de US \$1,5 milliard. De plus, environ 50 % des besoins en financement extérieur sont couverts par des organisations qui ne font pas partie des donateurs traditionnels dans le domaine de la santé internationale. Même s'il est parfois inévitable de perturber le fonctionnement des autres services de santé, ces perturbations sont en général de courte durée compte tenu de la nature des stratégies d'éradication. L'éradicabilité d'une maladie est fonction de la biologie du micro-organisme responsable et des outils de lutte dont on dispose. L'éradication de la poliomyélite répond aux trois critères de faisabilité technique de l'éradication d'un micro-organisme. En effet, bien que certains primates puissent être infectés par les poliovirus, il n'existe pas de réservoir non humain de la maladie. Le

vaccin antipoliomielítico buccal representa una intervención eficaz y la estrategia de jornadas nacionales de vacunación ha permitido interrumpir la transmisión misma en zonas donde la cobertura vacunal de base era débil. Finalmente, las culturas virales realizadas sobre muestras de heces en caso de parálisis flaccida aguda constituyen una herramienta sensible y específica de diagnóstico de la infección.

Más si se dispone de herramientas permitiendo interrumpir la transmisión y de diagnosticar la infección, los aspectos operacionales de su aplicación, sobre todo en condiciones difíciles, determinarán la factibilidad global de la erradicación de un microorganismo. La factibilidad operacional de toda iniciativa de erradicación reposa esencialmente sobre un compromiso social y político duradero. Para suscitar un tal compromiso, es necesario que la estrategia de erradicación haya sido ya probada en terreno en una vasta zona geográfica y que su eficacia haya sido demostrada, como lo atestigua, por ejemplo, la certificación de la erradicación de la poliomielitis en las Américas. Bien que el compromiso político vis-à-vis de la erradicación de la poliomielitis haya sido tomado durante la Asamblea mundial de la Salud en 1988, los progresos realizados hasta hoy los han obtenidos principalmente gracias al compromiso repetido, vis-à-vis de las actividades de erradicación, de los dirigentes de los países donde la enfermedad es endémica.

Como ya ha sido demostrado que la erradicación de la poliomielitis es técnicamente y operativamente factible, su éxito depende ahora de tres factores. Desde el principio, los logros actuales deben ser rápidamente consolidados por una aceleración del programa, en particular en los diez países prioritarios a nivel mundial (Afganistán, Angola, Bangladesh, República democrática del Congo, Etiopía, India, Nigeria, Pakistán, Sudán y Somalia). Después, los recursos financieros suplementarios son necesarios para realizar la aceleración demandada por la Asamblea mundial de la Salud en mayo 1999. Finalmente, es indispensable de mantener y de reforzar el compromiso al más alto nivel entre las agencias de las Naciones Unidas, los países endémicos, los países donantes y las organizaciones asociadas.

Durante su comentario de la conferencia de 1998 sobre la erradicación de las enfermedades, el Dr. W. H. Foege declaraba que «...la erradicación combate las desigualdades y ofrece la mejor respuesta en materia de justicia social». Cuando tales principios son asociados a ventajas humanitarias, económicas y a largo plazo de una iniciativa tal como la que está en curso contra la poliomielitis, el interés de la erradicación en tanto que estrategia de lucha contra la enfermedad no hace más que ser evidente.

Resumen

La erradicación de enfermedades como estrategia de salud pública: el caso de la erradicación de la poliomielitis

Pese a las razones humanitarias y económicas que hacen necesarias las iniciativas de erradicación de enfermedades, hay quienes cuestionan si los costos humanos y financieros de esas iniciativas justifican la concentración de esfuerzos requerida para erradicar una enfermedad. En ese sentido, se han celebrado recientemente dos reuniones internacionales para examinar la noción de erradicación como estrategia de salud pública: la primera en Dohá, Alemania, en 1997, y la segunda en Atlanta, EE.UU., en 1998. Diez años después del lanzamiento de la mayor iniciativa de erradicación jamás emprendida, es útil reexaminar la meta de la erradicación de la poliomielitis a la luz de los criterios propuestos en esas reuniones y plantearse las tres preguntas siguientes: «¿Por qué erradicar la poliomielitis?» (costos y beneficios); «¿por qué es técnicamente factible la erradicación de la poliomielitis?» (determinantes biológicos de la erradicabilidad); y «¿por qué es operacionalmente factible la erradicación de la poliomielitis?» (consideraciones sociales y políticas).

Una iniciativa de erradicación sólo se puede lanzar después de haberse demostrado que los efectos directos e indirectos son positivos. Los beneficios de la erradicación de la poliomielitis son, entre otros, una importante inversión en la prestación de servicios de salud, la eliminación de una causa importante de discapacidad, y efectos intangibles de largo alcance tales como el establecimiento de una «cultura de prevención» como la descrita en las Américas. Aunque los costos

financieros de la iniciativa son importantes, se estima que cuando cesen todas las medidas de lucha contra la poliomielitis se realizarán unas economías mundiales anuales de US\$ 1500 millones. Además, aproximadamente el 50% de las necesidades de financiación externa las cubren organizaciones que no solían donar fondos a favor de la salud internacional. Aunque a veces se producen inevitablemente trastornos en la administración de otros servicios de salud, suelen ser muy breves, debido a la naturaleza de las estrategias de erradicación. La erradicabilidad de una enfermedad depende de la biología del organismo causante y de los instrumentos disponibles para combatirlo. La erradicación de la poliomielitis satisface los tres indicadores de la viabilidad técnica de la erradicación de un microorganismo. Aunque los poliovirus pueden infectar a algunos primates, no existe un reservorio no humano. La vacuna oral contra el poliovirus es un arma eficaz, y la aplicación de la estrategia basada en la organización de días nacionales de inmunización ha interrumpido la transmisión del poliovirus incluso en zonas con baja cobertura de inmunización sistemática. Por último, se ha comprobado que el cultivo del virus a partir de muestras de heces de casos de parálisis flaccida aguda es un instrumento sensible y específico de diagnóstico de la infección.

Aunque se disponga de medios para interrumpir la transmisión y para diagnosticar la infección, las circunstancias operativas reales de su aplicación, en particular en situaciones difíciles, determinarán la

viabilidad general de la erradicación de un micro-organismo. El desarrollo y el mantenimiento de un compromiso social y político son elementos centrales de la viabilidad operacional de una iniciativa de erradicación. El desarrollo de ese compromiso requiere poner a prueba la estrategia de erradicación en una amplia zona geográfica y demostrar que es eficaz, como evidencia la certificación de la erradicación de la poliomiélitis en Las Américas. Si bien el compromiso político de erradicar la poliomiélitis se logró inicialmente en la Asamblea Mundial de la Salud de 1988, el compromiso con las actividades de erradicación suscrito repetidamente por los Jefes de Estado de los países con poliomiélitis endémica ha sido un factor clave en los progresos realizados hasta la fecha.

Habiéndose demostrado que la erradicación de la poliomiélitis es técnica y operativamente viable, el éxito depende ahora de tres factores. En primer lugar, los logros acumulados hasta la fecha tienen que consolidarse rápidamente acelerando el programa, en particular

en los diez países más prioritarios (Afganistán, Angola, Bangladesh, Etiopía, India, Nigeria, Pakistán, República Democrática del Congo, Sudán y Somalia). En segundo lugar, se necesitan recursos financieros adicionales para aplicar la aceleración pedida por la Asamblea Mundial de la Salud en mayo de 1999. Por último, es esencial mantener y reforzar el compromiso, al más alto nivel posible, de los organismos de las Naciones Unidas, los países con poliomiélitis endémica, las naciones donantes y las organizaciones asociadas.

En la conferencia que sobre la erradicación de la enfermedad se celebró en 1998, el Dr. W. H. Foege señaló que la erradicación combate las inequidades y favorece de manera incomparable la justicia social. Si a esos principios se añaden los beneficios humanitarios, económicos y de otro tipo de una iniciativa como la que está en marcha contra la poliomiélitis, hay razones de peso para considerar que la erradicación es una valiosa estrategia de lucha contra las enfermedades.

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